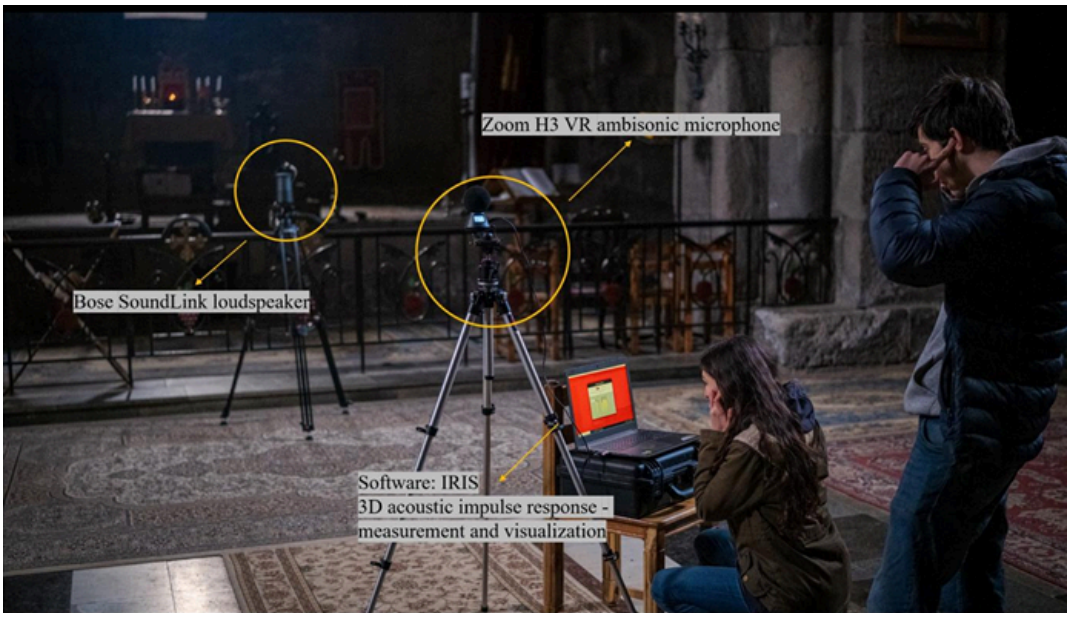
Acoustics Guidebook (Rev.A)

Setup, Data Acquisition, and Interpretation

Written by:

Ethan Bordeau
Astghik Papikyan
Sarah Gardner
Khushal Sharma
Aiden Sylvia



AUA
Հայաստանի Ամերիկյան Համալսարան

WORCESTER POLYTECHNIC INSTITUTE
LEHR UND KUNST
1865

COLUMBIA UNIVERSITY

Table of Contents

Guide Video.....2

1. Equipment and Planning.....3

2. Computer Setup.....4

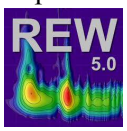
3. Equipment Setup.....7

4. Data Interpretation.....10

5. Equipment Takedown.....12

Guide Video
Link: https://youtu.be/dSEnjHD5PmA
QR Code:

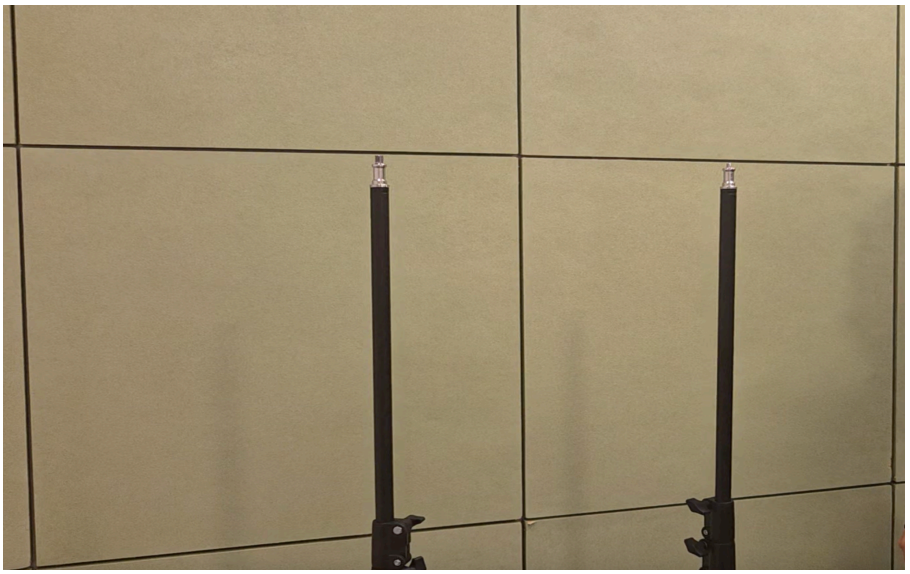
1. Equipment and Planning

Item	Role in the setup	Practical note
Zoom H3-VR microphone	Captures the room response at the measurement position.	Mount it on a tripod and keep it still during the sweep.
Bose SoundLink Revolve II	Acts as the sound source that plays the test sweep.	Place it on a stable raised surface and aim it towards the microphone.
Computer with REW & IRIS 	Controls the measurement and stores the recorded data.	Keep it near the microphone for easy monitoring.
Tripods	Keeps the microphone and the loudspeaker at a fixed height and position – adjustable level control.	Ear-height placement is a good starting point.
Cables	TSR (2x) – for connecting the wireless microphones. microUSB – for connecting the microphone to the computer.	Neatly coil cables after use.
Rode Wireless microphones	The TSR cable connects to the speaker and microphone.	Cables may need some tension.
Distometer	Measures distances accurately.	Measurement starts at the rear of the unit. Try measuring from the center of the microphone.
Thermometer	Measures the temperature of the room.	Temperature affects sound speed in air.

2. Equipment Setup

Open the equipment case and check that the microphone, speaker, cables, wireless microphones, distometer, and thermometer are present.

Open both tripods until they are both about ear height, roughly 1.2m. Attach the ZOOM H3-VR microphone to tripod 1 and the speaker to tripod 2.



Plug the microUSB to USB-A cable and the TSR-to-TRS cable into the wireless microphone.

Plug the TSR-to-TSR cable into the other wireless microphone.

Turn on the speaker and set the speaker volume to maximum. Turn on the Zoom H3-VR microphone

Play the test tone, then adjust the speaker output by increasing or decreasing the wireless microphone's decibel setting until it is as loud as possible without distortion or noise. We want as high a signal-to-noise ratio as possible. Start with the hardware decibel levels before moving into the software decibel levels.

On the Zoom H3-VR microphone, set the line out level:

Menu → Input/Output → Line Out Level → Set with Tone.

Adjust the level so the tone is loud and clear without distortion.

Orient the microphone so that it is pointing towards the speaker, the microphone's forward position should point down the room, and the screen should be aligned with the room's length.

Use the distometer to measure the receiver's height and the distance between the receiver and the speaker. Make sure the equipment is always at least a meter from any wall or reflective surface

Before each measurement, take a photo of the full setup. The photo should clearly show the positions of the source and receiver, as well as the room layout.

3. A basic diagram showing multiple source and receiver locations in a rectangular room.

4. Computer Setup

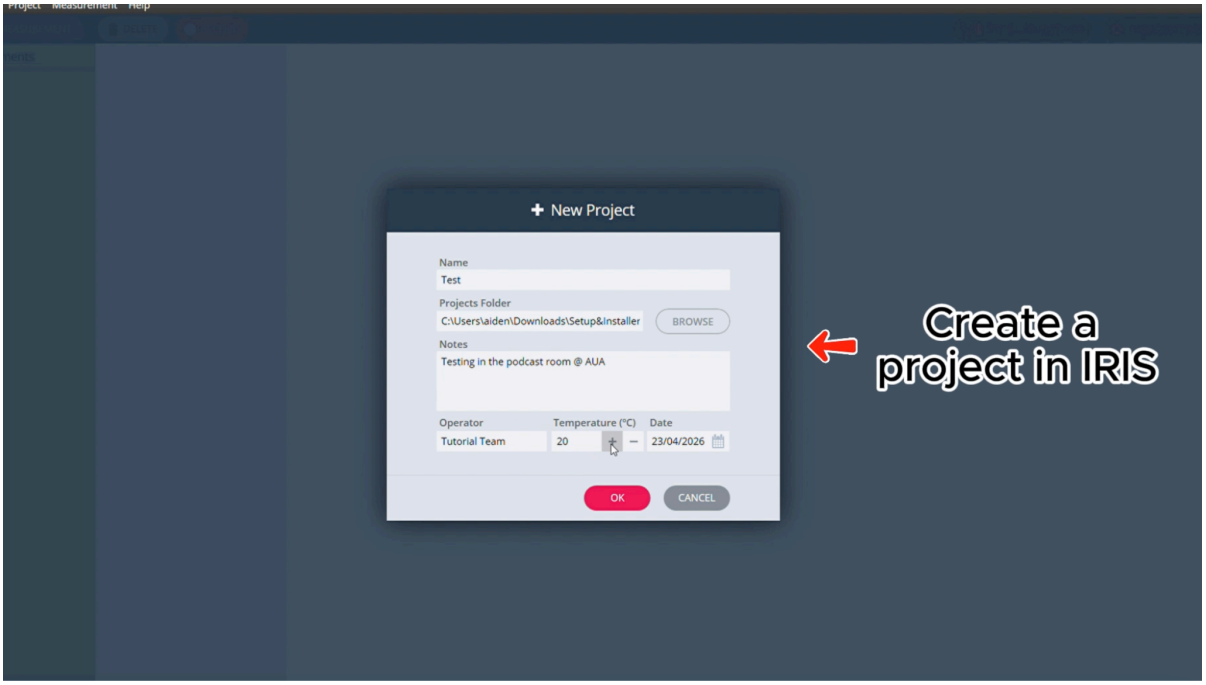
Place the computer close to the microphone so the operator can monitor recording levels during the measurement.
Plug the Zoom H3 VR microphone into the computer using the microUSB-to-USB-A cable. Plug the IRIS software key into the computer as well.
Turn on the Zoom H3-VR microphone. On the microphone, navigate to the following settings:

Menu → Rec Settings → Rec Mode → FuMa

Menu → USB → Audio I/F → 4ch Ambisonics[1]

Open IRIS and create a project. Fill in the project information:

- Name: Project name or site
- Operator: Team or person running the measurement
- Notes: Important room conditions, background noise, or setup details
- Temperature: Room temperature in Celsius
- Description: Measurement label such as “S1R1”[2]
- Source: Source position, such as “S1 - room location.”
- Receiver: Receiver position, such as “R1 - room location.”



[1] This allows the microphone to send four ambisonic channels to IRIS.
[2] Use the same naming convention for each measurement; e.g., S1R1 denotes source 1 and receiver 1. If you move the source, use S2R1. If you move the receiver, use S1R2.

Open “Audio Settings” in IRIS and use these settings:

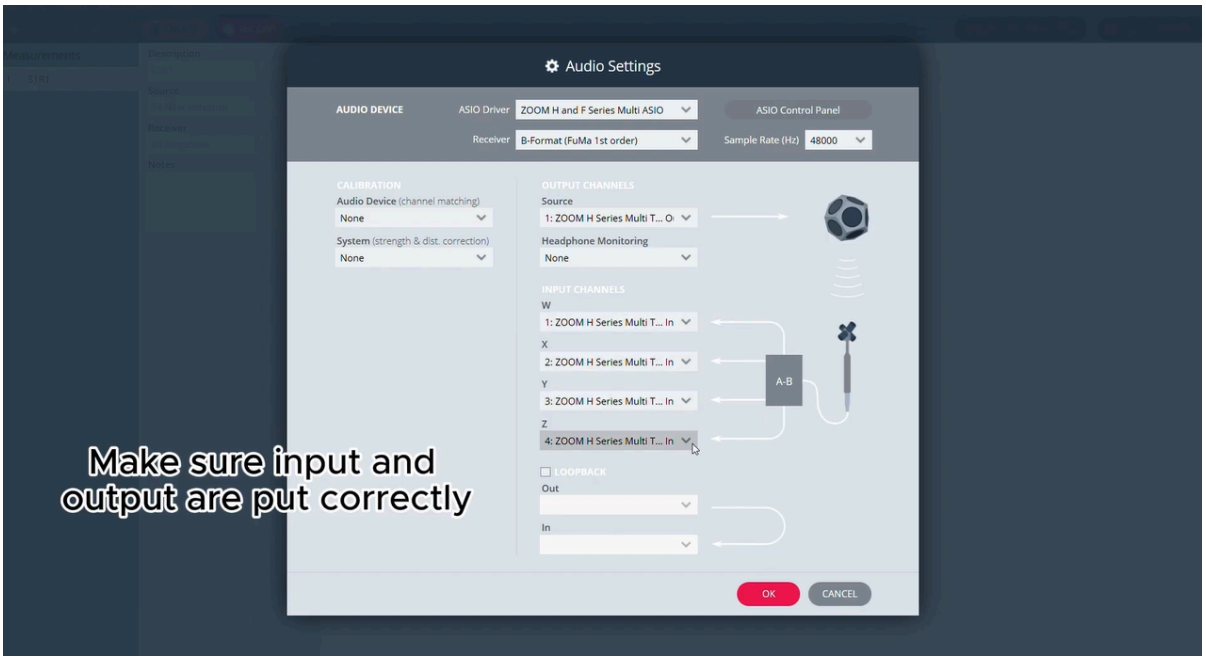
- Audio Device: ASIO Driver: ZoomH and F series Multi ASIO
- Receiver: B-Format (FuMa first order)
- Sample rate: 48000Hz

Output channels:

- Source: 1:Zoom H series multi Track Out
- Headphone monitoring: none

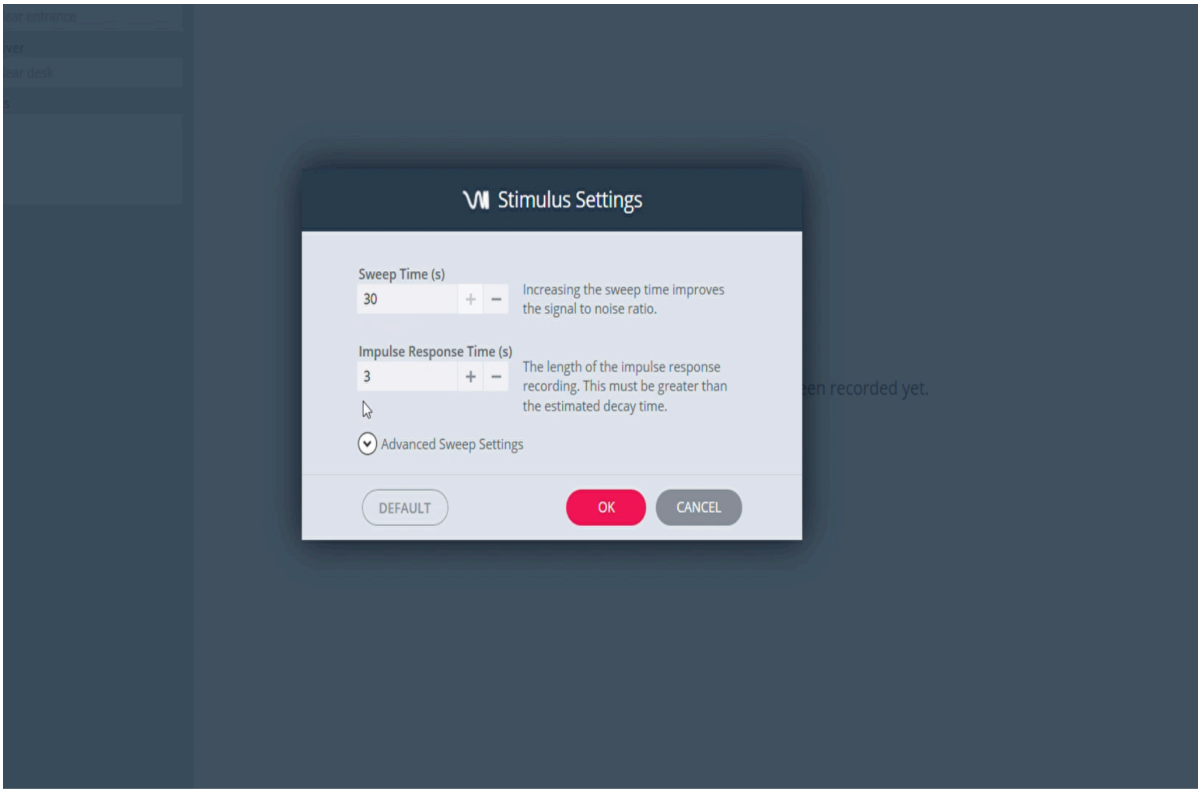
Input channels:

- W: 1:Zoom H series Multi Track In
- X: 2:Zoom H series Multi Track In
- Y: 3:Zoom H Series Multi Track In
- Z: 4:Zoom H Series Multi Track In



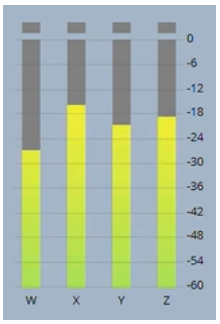
Open “Stimulus Settings” in IRIS. Set the sweep time and impulse response time.

- ➢ The maximum sweep time is 30 seconds, which is ideal.
- ➢ The impulse response time must be greater than the estimated decay time of the room.



Monitor the input levels as you record and ensure they do not reach the red clipping. If there is clipping, reduce the gain and test again. Ideally, the gain should be as close to zero as possible without clipping or distortion. Always adjust hardware first (see next section), and then software.

Observe the room noise levels before recording. The test sweep should be clearly above the ambient noise level, with sufficient headroom (about 6 to 12dB).



Run a test recording[3]. Move away from the microphone and cover your ears during the sweep. Listen for distortion or background noise. If the recording is distorted, clipped, or interrupted. Adjust the levels and record again.

[3] Make sure all input channels are visible before recording.

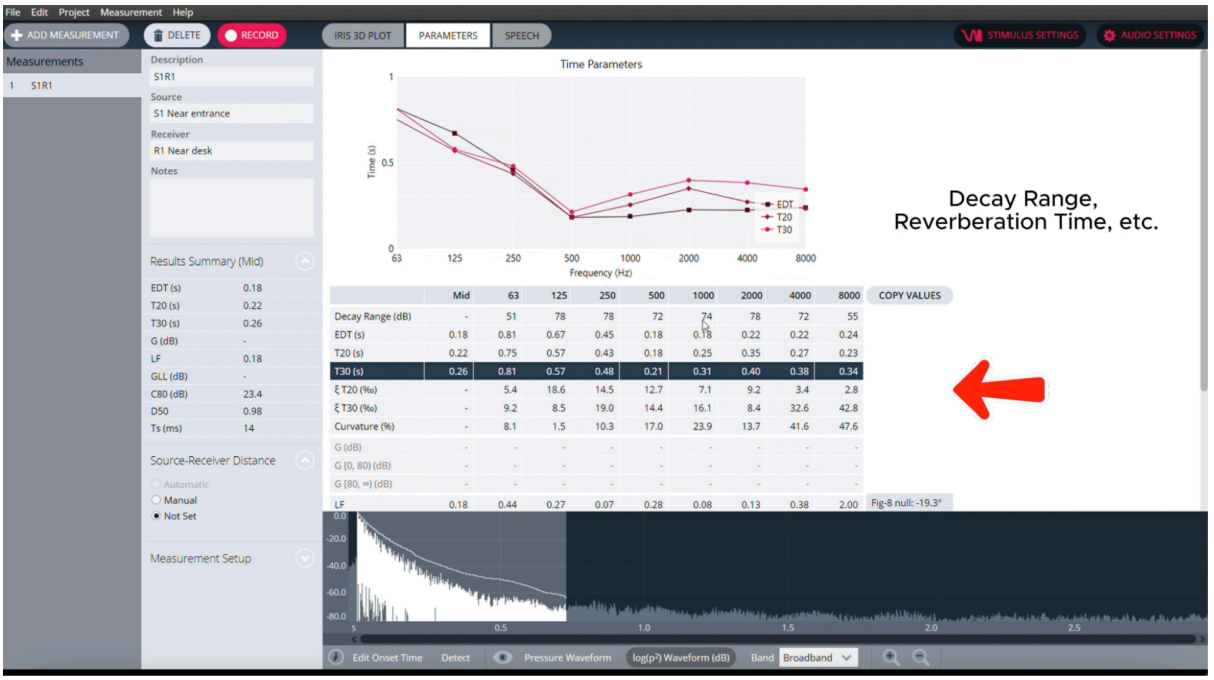
5. Data Interpretation

After each measurement, open the IRIS results and check whether the data is usable before interpreting the graphs.

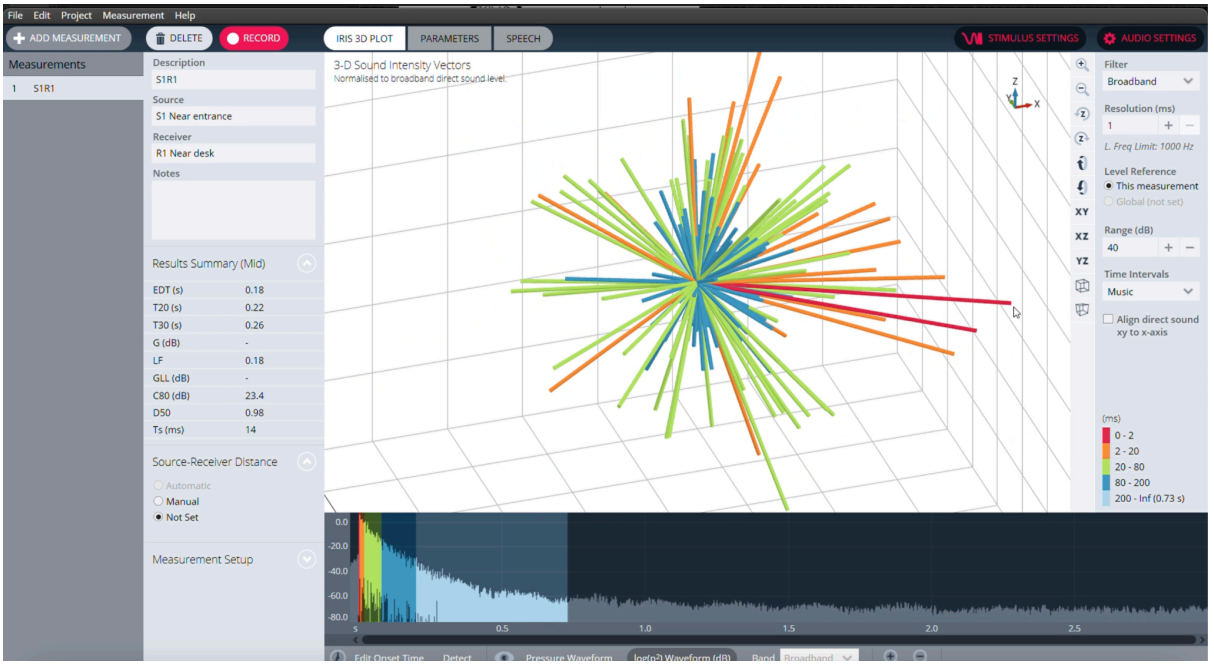
The left panel shows the measurement description, source position, receiver position, notes, and a mid-frequency results summary. This summary includes values such as EDT, T20, T30, C80, D50, LF, and Ts.

First, check the decay range. For T30, the decay range should be at least 45 dB; for T20, at least 35 dB. If the decay range is below these values, the measurement may not be reliable enough for the parameter.
T30 is the reverberation time calculated from a 30dB decay
T20 is the reverberation time calculated from a 20dB decay
EDT shows the early part of the sound decay and can be useful for understanding how quickly the room first responds after the sound source stops.
Use the table below the graph to compare values across frequency bands. Check the octave-band values rather than relying on the mid-frequency summary. Low and high frequencies may behave differently depending on the room and the measurement conditions.

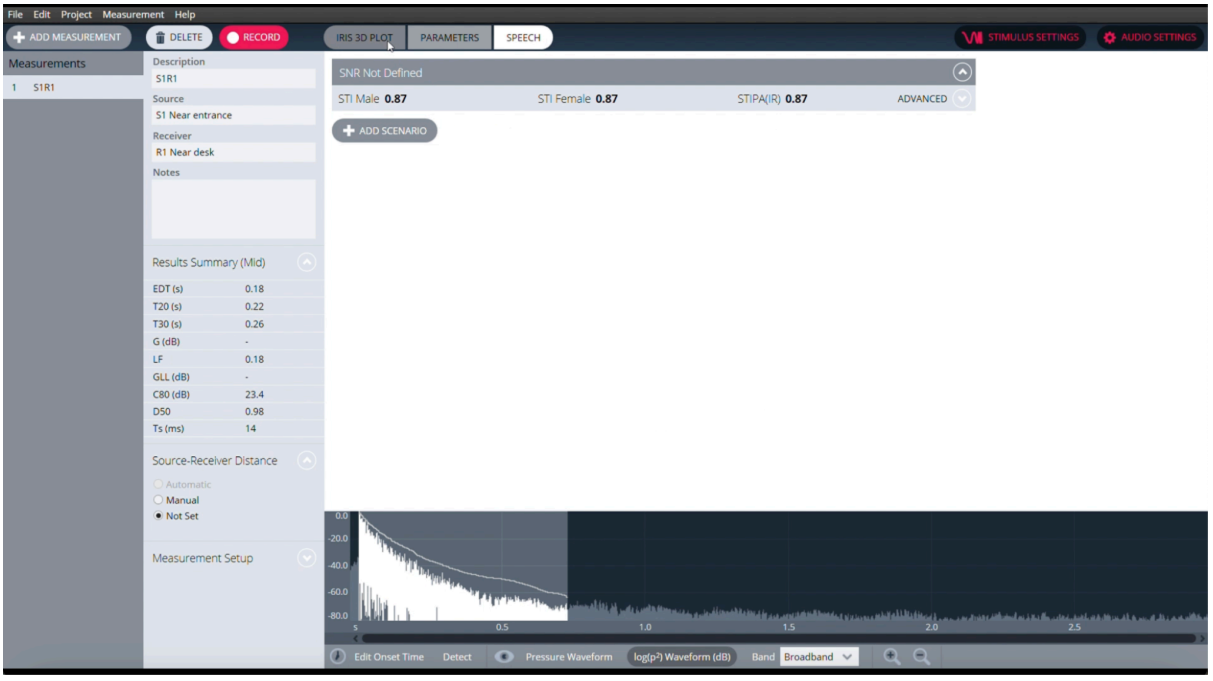
The waveform at the bottom of the screen shows the recorded decay over time. Use it to check whether decay looks clean.



Next, open the IRIS 3D plot tab to view the 3D sound intensity vectors. These vectors show the direction and relative strength of sound energy arriving at the microphone. The plot can be viewed at different resolutions and time intervals. Use the color scale in the 3D plot to see the directions of stronger and weaker sound.



Open the speech tab if speech intelligibility is being evaluated.IRIS shows values such as STI male, STI female, and STIPA(IR). This can help show how clearly speech would be understood in the measured space.



If a measurement has clipping, background noise, a low decay range, or a cut-off decay, mark it as questionable and repeat the measurement if possible. Compare results across multiple source and receiver positions before drawing conclusions

6. Equipment Takedown

    1. Power speaker off
    2. Power wireless microphones off
    3. Remove all cables and roll them neatly
    4. Turn the microphone off
    5. Remove the speaker and the microphone